SOLUTIONS

1.* Sketch each of the following continuous-time signals. For each case, specify if the signal is causal/non-causal, periodic/non-periodic, odd/even. If the signal is periodic specify its period.

(i) \( x(t) = 2 \sin(2\pi t) \)
(ii) \( x(t) = \begin{cases} 3e^{-2t}, & t \geq 0 \\ 0, & t < 0 \end{cases} \)
(iii) \( x(t) = 1/t \)

SOLUTION:
(i) Non-causal, because it takes non-zero values for \( -\infty < t < \infty \). Periodic with period 1. Odd because \( x(-t) = -x(t) \).
(ii) Causal, because it takes non-zero values for \( 0 \leq t < \infty \). Non-periodic. Neither odd nor even.
(iii) Non-causal, because it takes non-zero values for \( -\infty < t < \infty \). Non-periodic. Even because \( x(-t) = x(t) \).

2.* Sketch the signal

\[ x(t) = \begin{cases} 1-t, & 0 \leq t \leq 1 \\ 0, & \text{otherwise} \end{cases} \]

Now sketch each of the following and describe briefly in words how each of the signals can be derived from the original signal \( x(t) \).

(i) \( x(t + 3) \)
(ii) \( x(t/3) \)
(iii) \( x(t/3 + 1) \)
(iv) \( x(-t + 2) \)
(v) \( x(-2t + 1) \)

SOLUTION:
(i) Left shift by 3.
(ii) Linearly expand by factor of 3.
(iii) \( x(t/3 + 1) = x((t + 3)/3) \). Linearly stress (expand) by factor of 3 and shift left by 3.
(iv) Time reverse and shift right by 2.
(v) \( x(-2t + 1) = x[-2(t - 1/2)] \). Time reverse, linearly compress by factor of 2 and shift right by \( 1/2 \).
3.** Sketch each of the following signals. For each case, specify if the signal is causal/non-causal, periodic/non-periodic, odd/even. If the signal is periodic specify its period.

(i) \( x[n] = \cos(n\pi) \)

(ii) \( x[n] = \begin{cases} 0.5^{-n}, & n \leq 0 \\ 0, & n > 0 \end{cases} \)

SOLUTION:

(i) Non-causal, because it takes non-zero values for \(-\infty < n < \infty\). Periodic with period 2. Even because \( x[-n] = x[n] \). We all know how it looks like.

(ii) Non-causal, because it takes non-zero values for \(-\infty < n \leq 0\). Non-periodic. Neither odd nor even.

![Graph of the signal](image)

4.* Sketch the spectrum of the time domain signal.

(i) \( x(t) = \sin(2\pi \times 350t) + 0.35 \times \sin(6283t) + 0.1 \)

(ii) \( y(t) = 1.5 \times \cos(2199t) + \sin(2\pi \times 1000t + \pi / 2) \)

SOLUTION:

\( x(t) = \sin(2\pi \times 350t) + 0.35 \times \sin(6283t) + 0.1 \)

\( y(t) = 1.5 \times \cos(2199t) + \sin(2\pi \times 1000t + \pi / 2) \)

![Graph of the spectrum](image)
5.** (Optional Challenge)

It could be interesting to explore generating the signals in 4) in Matlab using the two functions provided in Lab 1 (i.e. sine_gen and plot_spec) to find out in practice the spectrum of the x(t) and y(t).

No solution required.